Ocean Model Development Panel (OMDP)

Co-Chairs
Simon Marsland (CSIRO, Australia), Gokhan Danabasoglu (NCAR, USA)

Mature: Coordinated Ocean-ice Reference Experiments (CORE-II)
Planned: Ocean Model Intercomparison Project (CMIP6/OMIP)
Emerging: New forcing product: JRA-55 (Japanese Re-analysis)

Thanks to Steve Griffies, Hiroyuki Tsujino, and OMDP

http://www.clivar.org/clivar-panels/omdp

Coordinated Ocean-ice Reference Experiments (CORE)

Normal Year Forcing experiment CORE-I

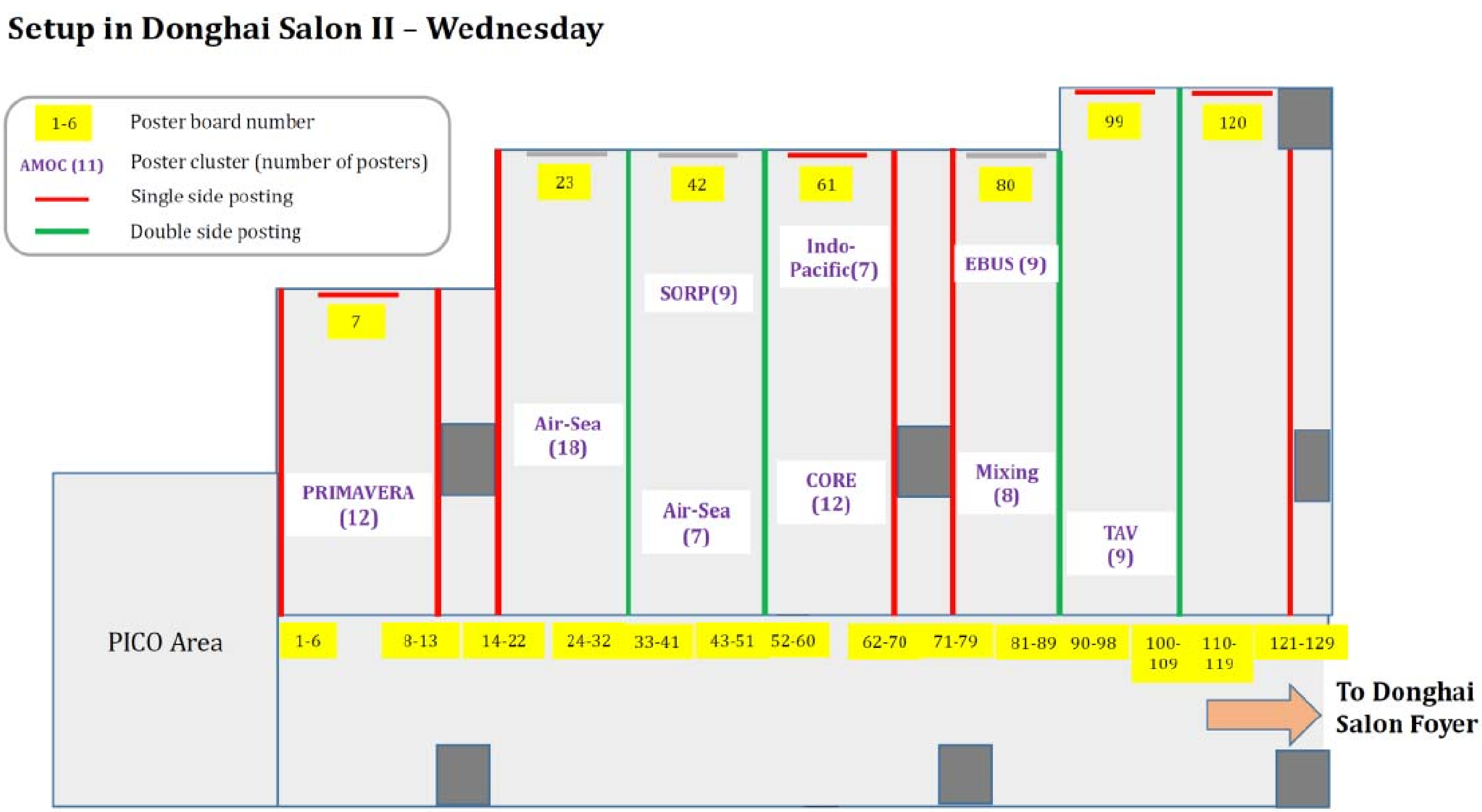
- Griffies et al., 2009, *Ocean Modelling*
- 500 repeat years with synoptic variability
- Large and Yeager (2009) corrected NCEP-NCAR reanalysis forcing
- Individual models choose own sea surface salinity restoring timescale
- Experiment for model-model intercomparison and benchmarking

Interannual Forcing Experiment CORE-II:

- Danabasoglu et al., 2014, *Ocean Modelling*
- 5 x Repeat cycle hindcast 1948-2007 with interannual variability
- Addresses science questions related to real world events
- CORE-II Virtual Special Issue of *Ocean Modelling* – now 9 papers published
- http://www.journals.elsevier.com/ocean-modelling/virtual-special-issues/virtual-special-issue-core-ii
- Atlantic x2, sea-level, southern ocean x2, arctic x3, pacific, ...

http://www.clivar.org/omdp/core

CORE-II Poster Cluster – Wednesday: 12 posters
Ocean and Climate Dynamics



Wednesday: Session 3 - 19:30-20:30
Ocean and Climate Modelling Town Hall Meeting

Ocean Model Intercomparison Project (OMIP)

Co-Chairs

Gokhan Danabasoglu (NCAR, USA)

Stephen Griffies (NOAA/GFDL, USA)

James Orr (IPSL, France)

Scientific Steering Committee

Physical Processes (CLIVAR Ocean Model Development panel, OMDP, & Collaborators

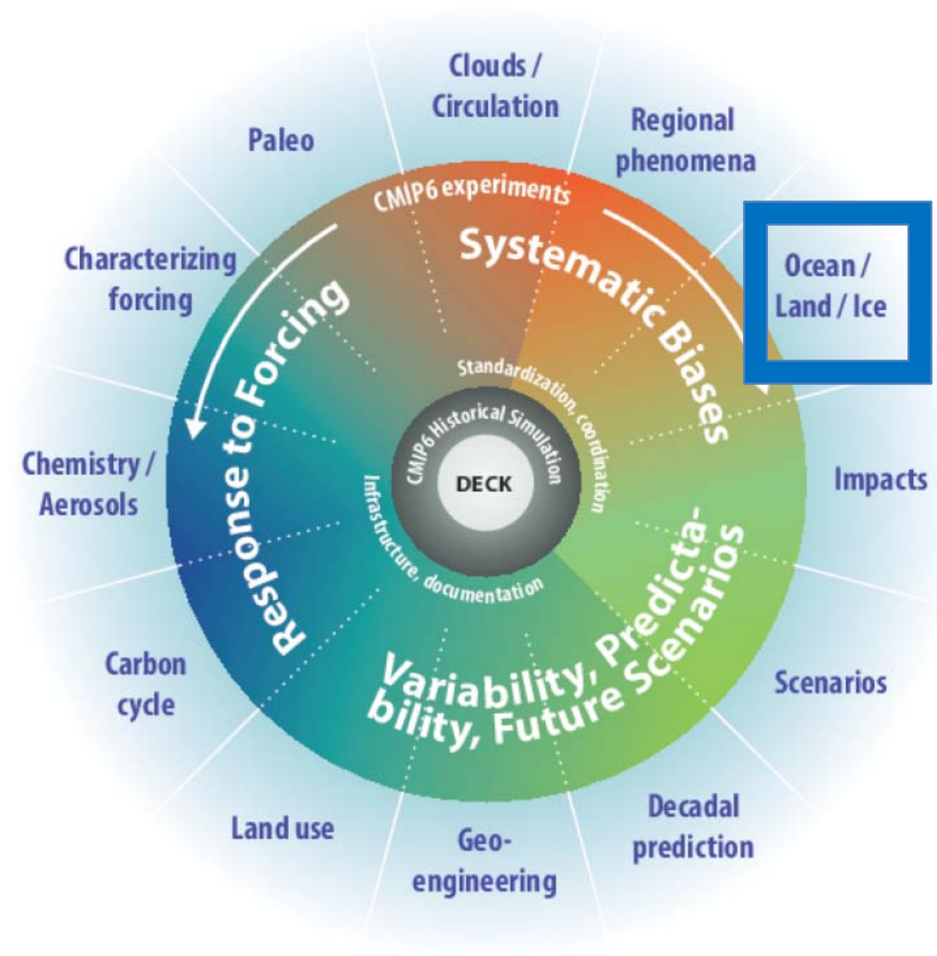
C. Boning, E. Chassignet, E. Curchitser, H. Drange, D. Holland, Y. Komuro, W. Large, S. Marsland, S. Masina, G. Nurser, A. Pirani, A.-M. Treguier, H. Tsujino, M. Winton, S. Yeager

Chemical and Biogeochemical Processes

L. Bopp, S. Doney, J. Dunne, F. Joos, G. McKinley, A. Oschlies, T. Tanhua, K. Lindsay

OMIP includes the previously separate Ocean Carbon Model Intercomparison Project (OCMIP). This merging of ocean physical, chemical, and biogeochemical efforts into a single project allows for efficient communication across these communities participating in CMIP6.

Ocean Model Intercomparison Project (CMIP6/OMIP)

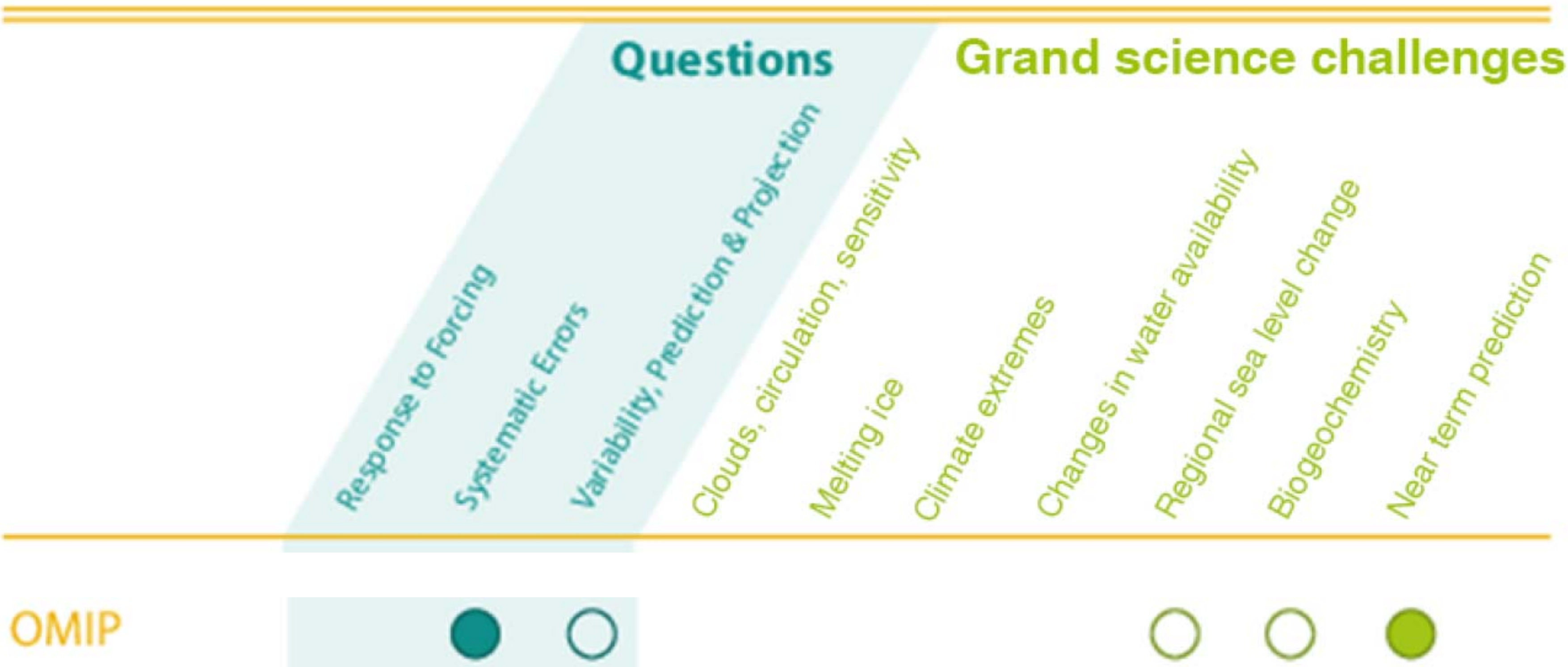


Eyring et al, GMD, 2016

	Questions: Response to Forcing	Questions: Systematic Errors	Questions: Variability, Prediction & Projection	Grand science challenges: Clouds, circulation, sensitivity	Melting ice	Climate extremes	Changes in water availability	Regional sea level change	Biogeochemistry	Near term prediction
AerChemMIP	●		○						●	○
C4MIP	●		○				○		●	
CFMIP	●	○		●			○			
DAMIP	●		○		○	●				
DCPP	○		●				○	○		●
FAFMIP	●	○		○				●		
GeoMIP	○		●	●		○	○			
GMMIP		●	○	●			○			○
HighResMIP	○	●		○			●			
ISMIP6	●		○		●			●		
LS3MIP	○	●			○		●			
LUMIP	●		○				○		●	
OMIP		●	○					○	○	●
PMIP	●	○		●					○	
RFMIP	●		○	●						○
ScenarioMIP	○		●			●	●		○	
VolMIP	●	○		○						○
CORDEX	○		●			●	○			
DynVarMIP	○	●		○						○
SIMIP	○	●			●					
VIACS AB	○		●			●	○	○		

Eyring et al, GMD, 2016

OMIP Science Goals



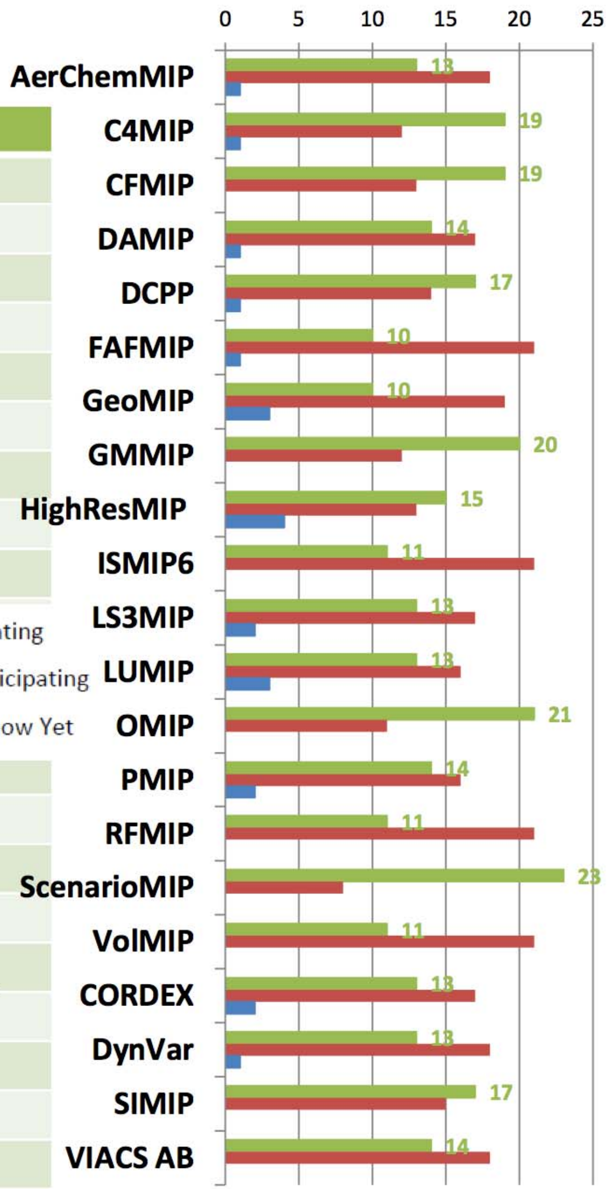
OMIP addresses the CMIP6 science question on investigating the origins and consequences of systematic model biases, by providing a framework for evaluating (including assessment of systematic biases), understanding, and improving ocean, sea-ice, tracer, and biogeochemical components of climate and earth system models contributing to CMIP6.

Among the WCRP Grand Challenges (GCs), OMIP primarily contributes to the regional sea-level rise and near-term (climate/decadal) prediction GCs.
e.g. initialisation states for decadal prediction

Endorsed MIPs for CMIP6 (October 2015)

CMIP6-Endorsed MIPs and Model Groups' Commitments to Participate in each MIP

	Long Name of MIP (Short Name of MIP)
1	Aerosols and Chemistry Model Intercomparison Project (AerChemMIP)
2	Coupled Climate Carbon Cycle Model Intercomparison Project (C4MIP)
3	Cloud Feedback Model Intercomparison Project (CFMIP)
4	Detection and Attribution Model Intercomparison Project (DAMIP)
5	Decadal Climate Prediction Project (DCPP)
6	Flux-Anomaly-Forced Model Intercomparison Project (FAFMIP)
7	Geoengineering Model Intercomparison Project (GeoMIP)
8	Global Monsoons Model Intercomparison Project (GMMIP)
9	High Resolution Model Intercomparison Project (HighResMIP)
10	Ice Sheet Model Intercomparison Project for CMIP6 (ISMIP6)
11	Land Surface, Snow and Soil Moisture MIP (LS3MIP)
12	Land-Use Model Intercomparison Project (LUMIP)
13	Ocean Model Intercomparison Project (OMIP)
14	Paleoclimate Modelling Intercomparison Project (PMIP)
15	Radiative Forcing Model Intercomparison Project (RFMIP)
16	Scenario Model Intercomparison Project (ScenarioMIP)
17	Volcanic Forcings Model Intercomparison Project (VolMIP)
18	Coordinated Regional Climate Downscaling Experiment (CORDEX)
19	Dynamics and Variability of the Stratosphere-Troposphere System (DynVar)
20	Sea-Ice Model Intercomparison Project (SIMIP)
21	Vulnerability, Impacts & Adaptation and Climate Services AB (VIACS AB)



Courtesy V. Eyring

OMIP Overview

OMIP provides a framework to:

- investigate physical, chemical, and biogeochemical mechanisms that drive seasonal, inter-annual, and decadal variability;
- attribute ocean-climate variations to boundary forced versus natural;
- evaluate robustness of mechanisms across models and forcing data sets;
- bridge observations and modeling by complementing ocean reanalysis from data assimilation;
- provide consistent ocean and sea-ice states useful for initialization of climate (e.g., decadal) predictions.

OMIP Part I:
Diagnostic analysis of CMIP6 ocean components

OMIP coordinates diagnostic analysis for all CMIP experiments that involve an ocean component. As part of this role, CLIVAR OMDP has produced two CMIP ocean model diagnostic papers that offer recommendations and scientific justifications for sampling ocean fields.

The OMIP diagnostic papers consist of three sections:

- Ocean physics
- Ocean inert chemistry
- Ocean biogeochemistry

CMIP Special Issue of Geoscientific Model Development

http://www.geosci-model-dev.net/special_issue590.html

S.M. Griffies et al, 2016: **OMIP contribution to CMIP6: experimental and diagnostic protocol for the physical component of the Ocean Model Intercomparison Project**, *accepted*.
J.C. Orr et al, 2016: **Biogeochemical protocols and diagnostics for the CMIP6 Ocean Model Intercomparison Project (OMIP),** *in review*.

CMIP6/OMIP Grids

- CMIP5 ocean diagnostic recommendation was for all variables on native model grid
- Allowed for full conservation in analysis and *metric* assessments
- But difficult for analysts outside modelling groups (e.g. tripolar Arctic, isopycnal)
- Conjecture this led to dearth of analysis on CMIP5 ocean diagnostics
- Potentially larger problem in CMIP6 –
  - more unstructured meshes: e.g. finite element/finite volume grids
  - more data: higher resolutions, more experiments (21 MIPS + ensembles etc.)

Customer First Focus

- Motivated to provide data of use to GSOP, and other communities such as AMOC, Southern Ocean, Mixing folk etc.

Pathway to Impact

- Increased uptake of CMIP6 ocean models by analysts
- Funding bodies notice
- Modelling groups benefit

CMIP6 ocean diagnostics recommendation:

- Horizontal: model groups remap to spherical grids
- WGCM Infrastructure Panel (WIP) CMIP6 special issue (Balaji et al., 2016) covers issues related to gridding and remapping
- Ideally use standard grid of Levitus (1982), Locarnini (2013)
- Anticipate much greater uptake/analysis of CMIP6 ocean fields
- Scalar fields conservative for diagnostics in budget analyses (e.g. air-sea fluxes)
- Horizontal vector fields interpolated onto common Arakawa A- or B-grid
- Recommendation non-compulsory (native grids still allowed)
- Possible to remap to courser resolution to reduce data burden of high-res models

Vertical Grids

- 3D fields on standard z, z*, p, or p*
- Vertical remapping should be conservative, online, each timestep

OMIP Part II: Global Ocean and Sea-ice Simulations

OMIP Tier 1 Simulation

One 310-year ocean – sea-ice hindcast simulation for the 1948-2009 period.

Path I: modeling groups unable to run with biogeochemistry can participate in the physical / chemical portion. Requirements:

- Potential (or Conservative) temperature
- Practical (or Absolute) salinity
- CFC11 (optional CFC12 and SF_6)

Path II: As in Path I, but with an online biogeochemistry model initialized from observed climatologies.

Forcing:

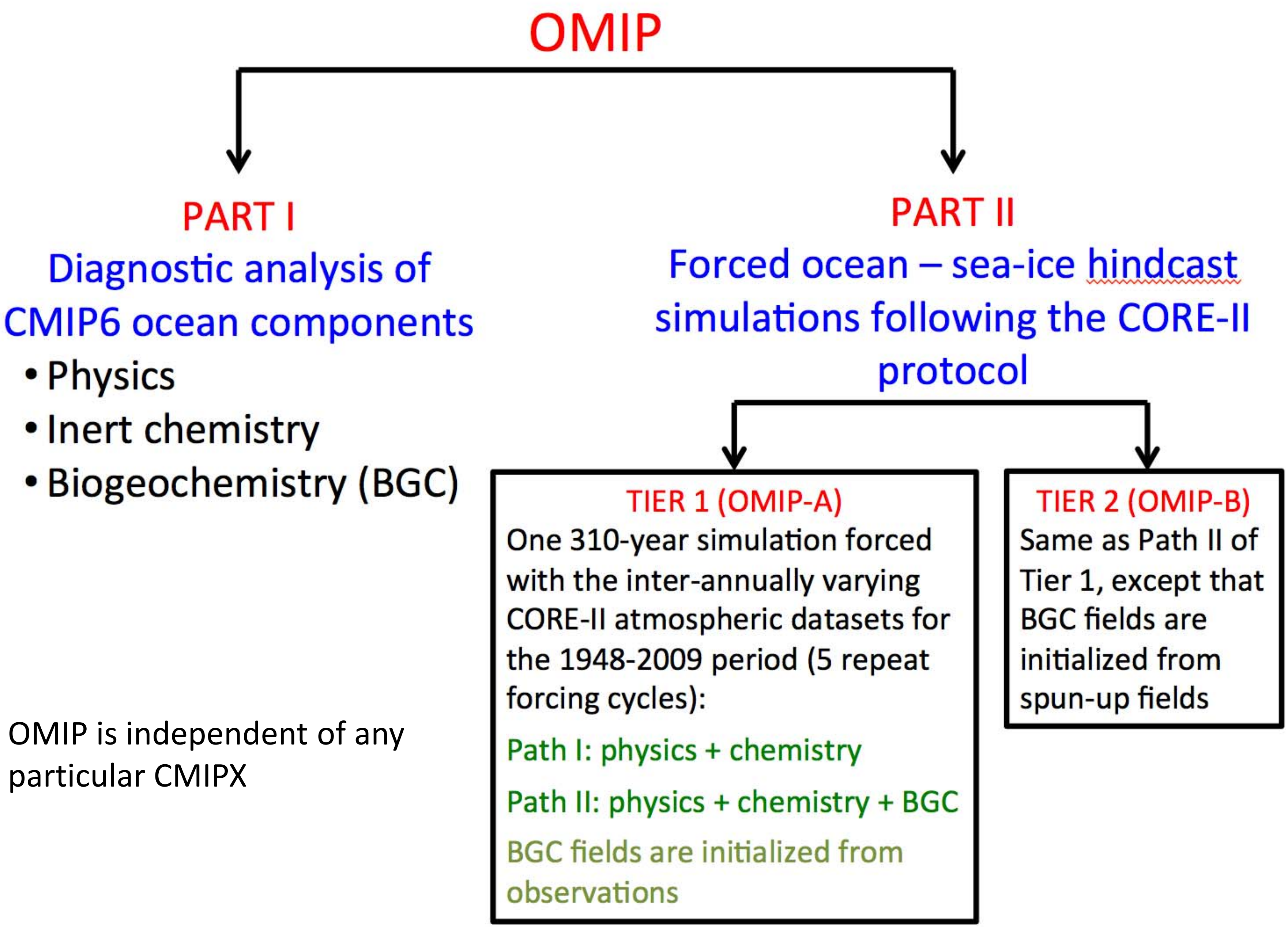
- CORE-II (interannually varying) following the OMDP CORE-II protocol.
- OCMIP2 protocol is followed for inert chemicals

OMIP Part II: Global Ocean and Sea-ice Simulations

OMIP Tier 2 Simulation

One 310-year ocean – sea-ice hindcast simulation for the 1948-2009 period.

- Spin-up: BGC millennial-scale spin-up
- Experiment: 310 year hindcast following CORE-II
- Forcing:
  - CORE-II protocol for physics
  - OCMIP2 protocol for inert chemicals
  - OCMIP3 protocol for BGC


OMIP
PART I
Diagnostic analysis of CMIP6 ocean components
• Physics
• Inert chemistry
• Biogeochemistry (BGC)
OMIP is independent of any particular CMIPX
PART II
Forced ocean – sea-ice hindcast simulations following the CORE-II protocol
TIER 1 (OMIP-A)
One 310-year simulation forced with the inter-annually varying CORE-II atmospheric datasets for the 1948-2009 period (5 repeat forcing cycles):
Path I: physics + chemistry
Path II: physics + chemistry + BGC
BGC fields are initialized from observations
TIER 2 (OMIP-B)
Same as Path II of Tier 1, except that BGC fields are initialized from spun-up fields

Japanese Re-analysis (JRA-55)

Weaknesses of CORE-II:

- Over 10 years old, produced 2004 (last updated 2009); no new updates anticpated
- Lower resolution (space and time) product

Strengths of JRA-55:

- Higher resolution (space and time) product as models go to higher resolution
- Near real-time updates (tackle science questions for 'current' events
    - e.g. "hiatus", 2015 El Nino, Arctic sea-ice decline, ...

Feature	JRA-55	CORE-II
Space resolution	55 km	200 km
Time resolution for the meteorology fields	8 times per day	4 times per day
Years available	1958-2015 (will be frequently updated)	1948-2009 (not updated)

Participation in CORE-II/JRA-55 comparisons:

- JMA-MRI , NCAR, GEOMAR-Kiel, ACCESS-Australia and more anticipated ...